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TRANSFORMATION OF CONSUMER PROPERTIES OF GOODS AND THEIR COMPETITIVENESS IN THE E-COMMERCE SYSTEM: A COMMODITY SCIENCE APPROACH TO THE DIGITAL MARKET

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Abstract. The article examines the transformation of the consumer properties of goods within the e-commerce system under the conditions of the emerging digital market and the development of a commodity science approach to product evaluation. The relevance of the study is determined by the rapid expansion of e-commerce, changes in the mechanisms of interaction between sellers and consumers, the growing role of digital platforms in shaping the market value of goods, and the increasing importance of information components in consumer decision-making processes. In these conditions, traditional approaches to defining product quality and competitiveness are being reconsidered. The aim of the study is to identify the specific features of the transformation of consumer properties of goods under the influence of e-commerce and to substantiate commodity

science approaches to their evaluation in the context of the digital market. The methodological framework is based on a systems approach, analysis and synthesis of scientific sources, comparative and structural-logical analysis of e-commerce processes, as well as a generalization of current trends in the development of the digital economy. The study finds that, in e-commerce conditions, the consumer properties of goods acquire an expanded meaning, as alongside traditional characteristics, digital product representation, the quality of visual content, information completeness, consumer reviews, and rating mechanisms play a significant role. It is demonstrated that the competitiveness of goods in the digital market is formed through the complex interaction of product quality characteristics, the effectiveness of digital marketing, the level of logistics services, and reputational factors. It is shown that modern commodity science is integrating with digital analytics tools, platform-based e-commerce models, and consumer data processing technologies, which enables new approaches to managing commodity flows. The practical significance of the results lies in their potential use by e-commerce entities to improve systems for evaluating consumer properties of goods, enhance product competitiveness, and optimize interaction processes with consumers in the digital market environment.

Keywords: consumer properties of goods, e-commerce, digital market, commodity science, product competitiveness, digital economy, marketplaces, digital platforms, consumer behavior.
JEL Classification: L81, M15, M31, D49, O33.

INTRODUCTION

The modern e-commerce environment is characterized by the intensive development of digital technologies, the expansion of the functionality of online platforms, the active integration of marketplaces into the system of commodity circulation, and significant changes in consumer behavior. This necessitates a reconsideration of traditional approaches to commercial commodity science, particularly regarding the assessment of product quality and consumer properties in the digital environment. Under current conditions, the importance of such factors as information transparency, the quality of digital content, electronic review systems, rating mechanisms, and the efficiency of communication with consumers is increasing.

The research problem lies in identifying the impact of e-commerce on the transformation of consumer properties of goods, the peculiarities of their perception by end consumers, and the formation of competitiveness in the digital market environment. Issues related to the adaptation of commodity science approaches to new models of product distribution, the application of digital technologies for product quality assessment, the management of product information, and ensuring effective interaction among market participants in the online environment remain highly relevant.

Thus, there is a need for a comprehensive study of the relationship between commercial commodity science, e-commerce, and digital tools for managing commodity flows in the context of enhancing product competitiveness and ensuring the effective functioning of the digital market.

LITERATURE REVIEW

Modern studies demonstrate that digital transformation and the development of e-commerce are radically changing approaches to commodity science, product quality management, and the formation of product competitiveness in digital markets. In the work of S. Biloruh, the concept of the big data economy and the digital economy is examined, emphasizing that data analytics becomes a key factor in shaping new market decisions and transforming consumer models. The author highlights that digital technologies change the logic of value creation and strengthen the role of information flows in ensuring competitive advantages [1].

Developing these provisions, V. Voronkova and co-authors consider digital transformation as a comprehensive process of modernization of management systems, within which technological innovations are integrated into the production and commercial activities of enterprises. The researchers emphasize that the digitalization of industrial management affects not only organizational structures but also decision-making mechanisms, forming a new management model focused on data, automation, and business process flexibility [2].

In the context of the commodity science approach, the work of V. Dykan, A. Kagramanian, and N. Kalycheva is of particular importance, as it systematizes the theoretical foundations of commodity science and commercial activity. The authors emphasize that the consumer properties of goods constitute a fundamental category determining their market value, while effective commercial activity is based on a deep understanding of product quality characteristics and their compliance with consumer needs [3]. Further development of these ideas can be observed in the study by V. Zhukovska and V. Klymanskyi, which analyzes the influence of digital technologies on the transformation of business processes in the field of e-commerce. The authors prove that digitalization changes not only sales channels but also the very structure of the formation of consumer value, increasing the importance of personalization, data processing speed, and interactive communication with consumers [4]. Within the framework of commodity science and commercial discourse, N. Kalycheva and B. Ostapiuk emphasize the relationship between classical approaches to commodity science and modern digital tools for commercial activity management. The researchers note that digital platforms transform product quality assessment mechanisms by expanding opportunities for analyzing consumer characteristics and creating competitive advantages in real time [5]. Issues related to the development of e-commerce in Ukraine are considered by D. Krylov, who notes that the growth of digital trading platforms stimulates market transformation, changes consumer behavior, and intensifies competition among enterprises. The author emphasizes that the key factors in the development of e-commerce are the digitalization of logistics, marketing strategies, and data management systems [6].

In a broader context, the impact of e-commerce on business models is examined by S. Shostak, L. Lypych, and S. Pavlova, who state that digital transformation contributes to the emergence of new sales models, innovative approaches to interaction with consumers, and changes in market structure. The authors emphasize that modern business models are becoming more flexible and data-oriented [10]. Concluding the review, D. Shchytov, K. Zhadko, and M. Mormul systematize the theoretical foundations of e-commerce by defining its essence, structure, and classification features. The researchers emphasize that e-commerce is a multi-level system of digital interaction among market participants that creates new conditions for the sale of goods and services [11]. The generalization of the presented approaches indicates that modern scientific thought considers e-commerce as a key environment for the transformation of consumer properties of goods and the formation of their competitiveness. At the same time, the complex relationship between commodity science analysis, digital sales channels, and mechanisms for managing competitive advantages of goods in the digital market environment remains insufficiently studied, which determines the relevance of further research.

PAPER OBJECTIVE

The purpose of the study is to substantiate the impact of e-commerce on the transformation of commercial commodity science, to identify the specific features of the formation of consumer properties of goods in the online environment, and to assess the factors ensuring product competitiveness in the digital economy. The objectives of the study are to analyze the impact of e-commerce and digital platforms on the development of commercial commodity science; to investigate changes in approaches to assessing the consumer properties of goods in the context of online commerce; to determine the role of digital content, consumer reviews, and rating systems in

shaping the perception of product quality; as well as to substantiate the relationship between digital marketing tools, commodity science characteristics, and product competitiveness in the electronic market.

METHODOLOGY

The research methodology is based on a systems approach to the analysis of the development processes of e-commerce and the transformation of commercial commodity science, which made it possible to comprehensively assess the relationships between digital sales channels, consumer properties of goods, and the level of their competitiveness. A comparative analysis of traditional and online forms of product distribution was applied, enabling the identification of key differences in approaches to product quality assessment, the formation of consumer demand, ensuring information transparency, and the influence of digital communications on consumer behavior.

A structural analysis of e-commerce tools, including marketplaces, rating systems, consumer reviews, digital content, and data analytics, was aimed at determining their functional capabilities, their role in shaping the consumer properties of goods, and their impact on the competitive positions of products in the digital market. The use of these methods ensured a comprehensive study of the interaction between commercial commodity science, e-commerce, and modern digital tools in the process of forming product competitiveness.

RESULT AND DISCUSSION

The formation of a modern approach to commercial commodity science is taking place under the influence of the profound digital transformation of the economy, which significantly changes the mechanisms for assessing product quality and the structure of product competitiveness. While the traditional model of commodity science was based on the physical analysis of products, laboratory testing, standardized quality control methods, and expert evaluations, under the conditions of e-commerce these approaches are supplemented by digital parameters reflecting the information and communication dimension of goods. Such parameters include digital product content, the quality of visual presentation, the completeness and structure of descriptions, the online reputation of the seller, rating and review systems, as well as user behavioral data. As a result, the consumer value of goods is increasingly formed not only through their physical characteristics but also through the manner of their presentation in the digital environment and the level of interaction with consumers on online platforms [3]. The development of marketplaces, social commerce, and e-commerce platforms causes a shift in focus from the material and physical properties of goods to their informational and representational characteristics [6]. This means that in the digital market, a product acts not only as a physical object but also as a multidimensional informational product that includes descriptive, visual, behavioral, and reputational components. Accordingly, commercial commodity science is transforming into an integrated system for analyzing the physical, digital, and behavioral characteristics of goods.

A key manifestation of this transformation is the change in the structure of consumer properties. In classical commodity science, physical-chemical, functional, ergonomic, and aesthetic characteristics dominated. Under the conditions of e-commerce, digital product attributes are becoming increasingly important, including the quality of multimedia content, the informativeness of descriptions, the availability and reliability of reviews, rating evaluations, the speed of information updates, and the level of digital accessibility of products for consumers.

At the same time, an additional layer of consumer value is formed through platform-mediated mechanisms that actively shape purchasing decisions. Algorithmic ranking systems, personalized recommendations, search engine optimization within marketplaces, and automated merchandising tools significantly influence product visibility and accessibility. These mechanisms create a

competitive environment in which even high-quality goods may lose market positions without adequate digital representation and optimization. Furthermore, behavioral and social signals generated by users become a critical component of product evaluation. Reviews, ratings, likes, shares, and engagement metrics function as forms of social validation that reduce consumer uncertainty and reinforce trust in online purchasing decisions. In this context, consumer perception is increasingly guided by collective digital intelligence rather than solely by individual assessment or expert opinion.

Consequently, the competitiveness of goods in e-commerce conditions is determined by a complex interaction between intrinsic product characteristics and extrinsic digital factors. This necessitates the development of new analytical frameworks within commercial commodity science that integrate data analytics, behavioral economics, and digital marketing principles to ensure a more comprehensive evaluation of product value in the online environment. These changes necessitate a reconsideration of approaches to product evaluation in the digital market, which can be summarized in a comparative characteristic (Table 1).

Table 1

Transformation of approaches to product evaluation in the e-commerce system

Criterion	Traditional Commodity Science	E-commerce
Source of information	Physical inspection, certification, laboratory testing	Digital content, platforms, reviews, ratings
Main product characteristics	Quality, safety, durability, functionality	Quality + information richness + digital reputation
Evaluation methods	Expert, measurement-based, standardized	Algorithmic, user-generated, data analytics
Demand formation	Indirect, through retail networks	Rapid, direct influence of digital channels
Role of the consumer	Passive recipient of information	Active co-creator of product evaluation
Spatial and temporal factor	Limited access to information	Continuous, global access

Source: compiled by the authors

As evidenced by the data presented in Table 1, e-commerce significantly expands the classical system of product evaluation by integrating digital, behavioral, and social parameters that form a new logic of consumer value perception. Such a transformation is caused by the transition from the traditional evaluation model, focused primarily on the physical characteristics of products, to a multidimensional analytical system that takes into account not only product quality but also the informational environment of its presentation and interaction with users of digital platforms.

Within the digital market, the consumer value of a product is formed as an integral result of the interaction between physical characteristics, informational representation, and social validation [1]. At the same time, increasing importance is attached not only to the product itself but also to the way it is digitally represented, which directly affects the perception of its quality and the expediency of purchase. The key digital determinants of consumer value include:

- the quality of visual and multimedia product presentation;
- the completeness, structure, and reliability of descriptive information;
- user review and rating systems;
- the speed of information updates on digital platforms;

- the level of trust in the seller or brand;
- logistics accessibility and delivery speed.

It should be noted separately that each of these factors performs not only an informational but also a behavioral function, forming a certain level of trust, expectations, and willingness to make a purchase among consumers [10]. As a result, the decision-making process becomes more complex, as it is based on the combination of rational product assessments and socio-psychological signals of the digital environment.

Thus, the consumer properties of goods in the context of e-commerce acquire a multidimensional character, since alongside traditional physical, functional, and qualitative characteristics, a new class of digital properties is being formed that directly influences consumer decision-making. This necessitates a reconsideration of commodity science approaches, within which a product is viewed not only as a material object but also as a digital and informational product integrated into a platform ecosystem [11]. As a result, the consumer value of goods is transformed into an integral category combining material, informational-communicational, and socio-behavioral parameters of the digital environment [4]. Such a multi-component structure of value forms new mechanisms of competitive struggle, where decisive importance belongs not only to the qualitative characteristics of goods but also to the effectiveness of their digital positioning, information flow management, and the level of interaction with consumers within online platforms.

In this context, the logic of forming product competitiveness in e-commerce should be presented as a sequential model of consumer value transformation (see Fig. 1), reflecting the transition from the physical characteristics of goods to their digital representation, social validation, and platform positioning [8]. Such a model makes it possible to systematize the stages of forming competitive advantages and emphasizes the growing role of the digital environment as a key space for shaping the market value of goods.

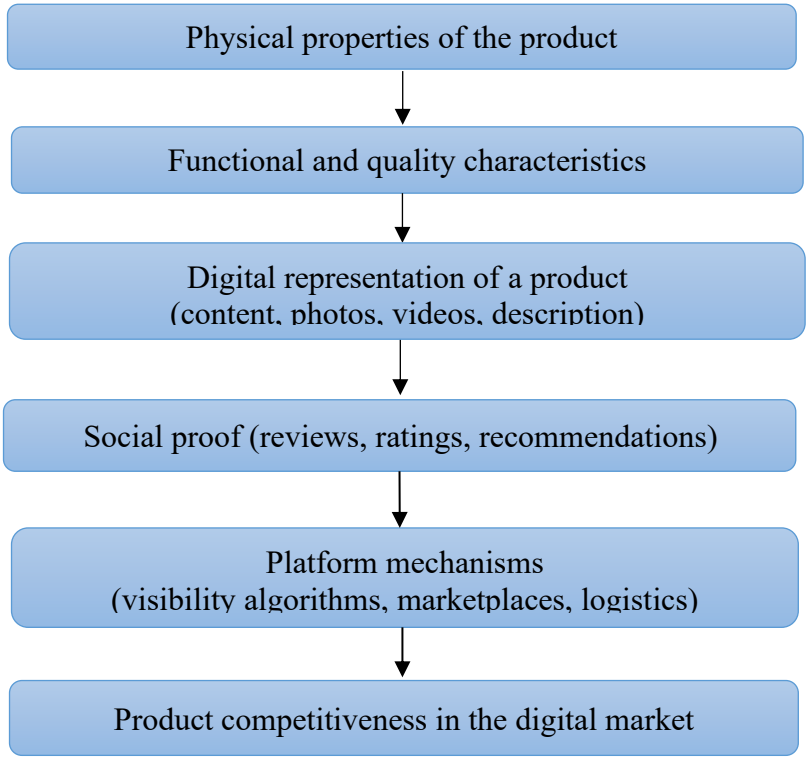

Figure 1. Formation of product competitiveness in the context of e-commerce

Source: compiled by the authors

Figure 1 illustrates the step-by-step logic of forming product competitiveness in the context of e-commerce, where the physical characteristics of a product are successively transformed into digital representation, social proof, and platform positioning [9]. Such structuring makes it possible to establish that product competitiveness in the digital environment is the result of the integration of material, informational, and behavioral factors that interact within electronic trading platforms. At the same time, the presented model is qualitative in nature, which necessitates its formalization for further analytical assessment of product consumer value. For this purpose, the integral consumer value of a product in e-commerce can be represented in the form of a mathematical model:

$$CV = \sum_{i=1}^{n} w_i X_i ,$$

where:

CV — the integral consumer value of a product in e-commerce;

X_i — components of consumer value (physical characteristics, digital content, reviews, rating, logistics service, etc.);

w_i — weighting coefficients of the significance of the corresponding components;

n — the number of considered parameters.

The proposed model allows us to view product consumer value as a multi-component category formed under the influence of both traditional commodity characteristics and digital parameters inherent in e-commerce. The weighting coefficients within the model reflect the varying degree of influence of individual factors on the final consumer evaluation of the product, which necessitates their differentiated consideration depending on market specifics, product category, and target audience behavior. In this context, the flexibility of weighting parameters enables the model to be dynamically adjusted in response to changes in the digital environment, including shifts in platform algorithms and consumer engagement patterns. Consequently, the model can be applied as an adaptive analytical tool for supporting managerial decisions in online product positioning and competitiveness assessment. In the digital economy, product competitiveness is determined not only by its objective quality but also by its ability to adapt to the operating conditions of digital platforms and algorithmic ranking mechanisms [2]. This implies a comprehensive transformation of approaches to product offering management, in particular through the integration of data-driven decision-making tools and continuous optimization of digital content. It also involves the systematic use of analytics to adjust product positioning in response to changes in consumer behavior and platform algorithms.

- optimization of product digital content to enhance its visibility and attractiveness to consumers;
- effective management of online reputation, including handling reviews and ratings;
- integration of product listings into the logic of marketplace algorithms;
- ensuring fast, reliable, and transparent logistics as a component of consumer value;
- personalization of product offerings based on the analysis of user behavioral data.

Thus, product competitiveness in the context of e-commerce acquires a systemic nature and is formed as a result of the interaction of physical, digital, and behavioral components within a unified information and market environment, where both the properties of the product itself and the specifics of its presentation and perception in the online space play a significant role [9]. In these conditions, modern commercial commodity science within the digital market is transforming into a multi-level analytical system that combines classical commodity science approaches with digital analytics tools, big data processing, and platform technologies [5]. Such an evolution leads to the expansion of its functional structure, which includes an enhanced capacity for real-time monitoring of product performance indicators across digital channels. It also enables more accurate forecasting of consumer demand and competitive positioning based on continuously updated behavioral and transactional data.

- assessment of the physicochemical and functional properties of products;
- analysis of digital characteristics of product offerings;
- monitoring consumer behavior on e-commerce platforms;
- analysis of reviews, ratings, and social signals;
- forecasting demand based on digital data;
- evaluation of the competitive environment in online sales channels.

These directions reflect the transition from a traditional commodity science approach to an integrated digital-analytical model for managing product characteristics and market behavior of goods. A summary of the main factors shaping product competitiveness in the digital environment is presented in Table 2.

Table 2

Factors of product competitiveness formation in the e-commerce system

Factor Group	Content	Role in Shaping Competitiveness
Quality	materials, reliability, functionality	basic product value
Digital	content, SEO optimization, multimedia	demand formation and visibility
Behavioral	reviews, ratings, recommendations	building trust and social proof
Platform	ranking algorithms, logistics, delivery	product accessibility and positioning
Marketing	advertising, branding, promotions	stimulating demand and sales

Source: compiled by the authors

Thus, e-commerce forms a fundamentally new paradigm for the development of commercial commodity science, in which the consumer properties of goods and their competitiveness are determined by the integration of physical, digital, and socio-behavioral factors. This necessitates a rethinking of classical commodity science approaches and the formation of new analytical models oriented toward the conditions of the digital market and the platform economy.

CONCLUSION

Thus, the study has established that the development of e-commerce and the digitalization of the market environment significantly transform the nature of consumer properties of goods, expanding their content through the inclusion of digital, information-communication, and behavioral characteristics. Traditional commodity science approaches, which were primarily based on the physico-chemical, functional, and operational parameters of products, are gradually being supplemented by the analysis of digital content, online reputation, rating systems, and consumer reviews, which are becoming key determinants of consumer choice. It has been found that in the conditions of the digital market, the consumer value of a product is formed as an integral category that combines the material characteristics of the product and its informational representation in the online environment. A significant role in this process is played by marketplaces, ranking algorithms, e-commerce platforms, and mechanisms of social proof, all of which substantially influence product perception and market positioning. As a result, product competitiveness is determined not only by quality but also by the effectiveness of its digital representation and its ability to adapt to the requirements of the platform economy.

The synergy of classical commodity science approaches and digital technologies leads to the formation of a new stage in the development of commercial commodity science as a multi-level analytical system oriented toward processing both physical and digital product parameters. This

makes it possible to improve the accuracy of assessing consumer properties, enhance mechanisms for managing product offerings, and ensure more efficient functioning of e-commerce entities.

The prospects for further research are related to an in-depth study of the role of artificial intelligence and big data in shaping the consumer properties of goods, as well as the development of new models for assessing their competitiveness in the context of the dynamic development of digital platforms. Particular attention should be given to investigating the impact of algorithmic marketplace systems on the structure of consumer choice and the transformation of buyer behavior in the digital environment.

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ТРАНСФОРМАЦІЯ СПОЖИВЧИХ ВЛАСТИВОСТЕЙ ТОВАРІВ ТА ЇХ КОНКУРЕНТОСПРОМОЖНІСТЬ У СИСТЕМІ ЕЛЕКТРОННОЇ КОМЕРЦІЇ: ТОВАРОЗНАВЧИЙ ПІДХІД ДО ЦИФРОВОГО РИНКУ

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У статті досліджується трансформація споживчих властивостей товарів у системі електронної комерції в умовах становлення цифрового ринку та розвитку товарознавчого підходу до оцінювання продукції. Актуальність дослідження зумовлена стрімким розширенням електронної торгівлі, зміною механізмів взаємодії між продавцем і споживачем, посиленням ролі цифрових платформ у формуванні ринкової вартості товарів та зростанням значення інформаційної складової в процесі прийняття споживчих рішень. У цих умовах відбувається переосмислення традиційних підходів до визначення якості та конкурентоспроможності товарів. Метою дослідження є виявлення особливостей трансформації споживчих властивостей товарів під впливом електронної комерції та обґрунтування товарознавчих підходів до їх оцінювання в умовах цифрового ринку. Методологічну основу становлять системний підхід, аналіз і синтез наукових джерел, порівняльний та структурно-логічний аналіз процесів електронної торгівлі, а також узагальнення сучасних тенденцій розвитку цифрової економіки. У результаті дослідження встановлено, що в умовах електронної комерції споживчі властивості товарів набувають розширеного змісту, оскільки поряд із традиційними характеристиками значну роль відіграють цифрова репрезентація товару, якість візуального контенту, інформаційна повнота, відгуки споживачів та рейтингові механізми. Доведено, що конкурентоспроможність товарів на цифровому ринку формується під впливом комплексної взаємодії якісних характеристик продукції, ефективності цифрового маркетингу, рівня логістичного обслуговування та репутаційних факторів. Показано, що сучасне товарознавство інтегрується з інструментами цифрової аналітики, платформними моделями електронної комерції та технологіями обробки споживчих даних, що забезпечує нові підходи до управління товарними потоками. Практичне значення результатів полягає у можливості їх використання суб'єктами електронної комерції для удосконалення систем оцінювання споживчих властивостей товарів, підвищення конкурентоспроможності продукції та оптимізації процесів взаємодії зі споживачами в умовах цифрового ринку.

Ключові слова: споживчі властивості товарів, електронна комерція, цифровий ринок, комерційне товарознавство, конкурентоспроможність товарів, цифрова економіка, маркетплейси, цифрові платформи, споживча поведінка.